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WELUT - 02 PROJECT
REPORT 2200
LOGICAL CAPABILITIES OF THE GIS

BY

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I. INTRODUCTION

A. Goal of the Project

This project is defined and sponsored by the Western Energy and Land Use Team (WELUT) to promote more effective consideration of fish and wildlife resources in the numerous state and federal decisions concerning western land, energy, mineral, and water resources.

The goal of this two year project is to develop an operational capability within the U.S. Fish and Wildlife Service (FWS) to accept, store, manipulate, and output spatially related data for use in a variety of FWS programs. This includes not only the data that has been and will continue to be collected by the FWS, but also includes data available in computerized and non-computerized data files of other federal and state natural resource management agencies. This goal is to be achieved with minimal development of new computer software and minimal hardware requirements. The project will start on a prototype basis within selected test case areas and will broaden to other applications.

The primary operational level users of this system in its developmental stages are in the Billings Area Office (BAO) of the U.S. Fish and Wildlife Service. The biologists in this office are faced with the weekly task of assessing the wildlife resource impacts of various land use changes. This project will attempt to develop simple, useable, practical tools for operational use at the regional and area office level.

This report culminates the first of seven project tasks. Other technical reports will be produced as the system development proceeds.

B. Scope of this Report

This report will outline the wide variety of technical capabilities of the WELUT - 02 Geographic Information System (GIS) which will be produced by October 1978 under contract number 14-16-0008-2155. Four distinct results should arise from this report:

1.) This paper effectively "freezes the design" of all GIS capabilities so that WELUT managers will know, in detail, exactly what they will, and will not get from the GIS.

2.) This paper serves as an applications software design requirement for those commands not yet programmed.

3.) This paper will give field users and research biologists a complete look at the power and flexibility of the GIS capabilities as it will be delivered in October 1978.

4.) This paper allows FWS researchers and users to comment both on detailed GIS capabilities and on the method of their documentation. These capabilities will be summarized in a similar manner in the GIS Users Manual.

II. CAPABILITIES OF THE GIS (AS OF OCTOBER 1978)

A. Summary List of the GIS Capabilities/Commands

The following set of GIS capabilities are being developed as part of the Second Year FRMS Work Plan. The summarized table that follows gives the command name and a very brief description of its capabilities. For full descriptions of command capabilities, see Sections II-B-1 through II-B-8 which give significantly more detail for each command.

COMMAND NAME	SUMMARIZED DESCRIPTION
GENERAL COMMANDS	
1. COST	Produces costs, CPU time, and resourses used within a GIS run.
2. FINISH	Terminates a GIS run.
3. HELP	Produces summary lists of all available GIS commands or detailed explanation of each individual command.
4. NEWS	Produces narrative information on recent changes to the GIS.
INPUT AND EDIT COMMANDS	
5. DIGITIZE	Allows the operator to digitize points, lines, or arcs from a map using the ALTEK table and the Data General Eclipse.
6. EDIT	Allows the operator to edit point, line, arc, or polygon coordinates or descriptors. Additions, deletions, or modifications of the above are possible using the Data General Eclipse.
7. DISPLAY	Displays a digitized map on the Tektronix CRT or on the Versatek printer/plotter.
8. DUMP	Produces a systems dump of the entire map data file including coordinates and map descriptors. (Exactly the same as the DBMS command.)
9. POST EDIT	This command performs final editing of points, lines, arcs, or polygons; checks topology of arc files; and produces a clean file ready for input into the DBMS.
DATA BASE MANAGEMENT SYSTEM (DBMS) COMMANDS	
10. LIST	Allows the user to browse at either the file level, the map category level, or the map subject level for any digitized map in the DBMS.
11. ACTIVE	Produces a printout on the CRT displaying all activated polygon, cellular or textual data sets.
12. STATUS	Produces summary statistics on the size and complexity (number of coordinate pairs) of any map in the DBMS or any active map data set.
13. SAVE	Stores an active map data set in a user work file for later use.

COMMAND NAME	SUMMARIZED DESCRIPTION
14. FREE	Selectively deactivates activated map data sets.
15. DUMP	Selectively lists the entire contents of a map file including coordinates and map descriptors on the line printer.
DISPLAY COMMANDS	
16. SHADE	Plots on the CRT and shades with differential cross-hatching, any active polygon map.
17. PLOT	Displays on the CRT selected points, lines, or polygons in a controlled manner.
18. SYMBOL	Plots on the CRT any one of twenty-three possible symbols (circles, boxes, etc.) around any point in a map file.
19. LEGEND	Generates a full map legend including scales, representative fraction, north arrow, title, subject, etc. for any previously plotted map.
20. CONTOUR	Generates a contour map from a grid surface.
21. THREE-D	Produces a three dimensional plot of any 2-D matrix map using cell attributes as the Z value.
22. ERASE	Erases the CRT.
23. WRITE	Writes a polygon line or cell map to a peripheral device including line printer, Calcomp plotter, disc, or tape.
24. WINDOW	Sets the CRT virtual viewing area to correspond to a particular area on the earth's surface at a given scale. Corner points of the window are specified using UTM coordinates.
25. RESET	Sets the virtual viewing window back to the original scale (as it was before a BLOWUP command was issued).
26. BLOWUP	Enlarges or magnifies a portion of the virtual viewing window based on user specifications.
27. LINE	Allows for up to eighteen line symbologies to be used on a map for display purposes (e.g. _ _ _, ---------, ___, etc.).
MEASUREMENT COMMANDS	
28. LENGTH	Calculates and prints out the length (in meters and in miles) of all lines and the perimeters of all polygons of a given map.

COMMAND NAME	SUMMARIZED DESCRIPTION
29. DISTANCE	Measures the distance, in meters, between any two points on a CRT screen either along a straight line or along a sinuous line (such as a highway or vegetation edge).
30. AREA	Calculates and prints out the area, in hectares and in acres, of all unique polygon subjects in an active map (islands are excluded).
STATISTICAL COMMANDS	
31. FREQUENCY	Calculates and prints out the frequency of each unique subject in an active map.
32. HISTOGRAM	Produces a labeled bar chart of either a) the frequency of occurrence of polygon subjects, b) the length of line types by subject, or c) the area of polygon types by subject.
33. CROSSTAB	Produces a standard bivariate cross tabulation of the contents of any two cell maps.
34. REGRESSION	Performs a multiple regression on a set of cell maps.
35. DESCRIBE	Calculates and prints out the mean, variance, standard deviation, range, minimum and maximum values of specific area, length, or frequency attributes of any given map.
36. ANOVA	Establishes a one way analysis of variance of cell data between two cellular maps.
37. GRAPH	Produces a user specified and labeled chart of map characteristics.
SPATIAL RETRIEVAL COMMANDS	
38. SELECT	Activates either all or a specific subset of any polygon, arc, or cell map data set.
39. SIZE	Retrieves those polygons or lines from the map file which satisfy the minimum and maximum size requirements.
40. PROXIMITY	Selects all polygons, lines, or points from an active map which are within a user specified distance (X) of a given point, line or polygon set.
41. CONTIGUITY	Finds all polygons of subject type A which are adjacent to polygons of subject type B.

COMMAND NAME	SUMMARIZED DESCRIPTION
42. EDGE	Finds all occurrences where polygon subject type A borders polygon subject type B. The common lineal border or edge is saved as a new map.
43. STUDY AREA	Allows the user to splice together several map sets of the same subject covering different geographical areas (i.e. several county soil maps into a regional soil map).
ANALYSIS COMMANDS	
44. OVERLAY	Superimpose an infinite number of active polygon maps to produce a new map that shows all possible intersections or unions between input polygons.
45. POLYCELL	Converts an activated point, line, or polygon map to an active cellular map at user specified cell size.
46. CELLPOLY	Converts an active cell map back to an active polygon map with optional smoothing.
47. VIEWSHED	Allows the calculation of all areas seen from a given point and vice versa.
48. BUFFER	Draws and optionally stores a buffer zone of user specified radius around any active map containing points, lines, or polygons.
49. COMPOSITE-ARITHMETIC	Allows for mathematical compositing of up to ten cell maps. A resulting cell map is produced.
50. COMPOSITE-LOGICAL	Allows for BOOLEAN logical combinations of an up to ten cell maps. A resulting cell map is produced and stored.
51. SLOPE	Allows the user to transform a cell matrix elevation map into relative slopes with user determined intervals.
52. ASPECT	Allows the user to transform a cell matrix elevation map into relative aspects (N,NE,E,SE,etc.).
53. GRID	Performs a point to grid interpolation as required for viewshed, contouring, or three dimensional analysis.
54. TESTGRID	Superimpose a user specified grid on any polygon map, Primarily for use in determining a good cell size for polygon to cell (POLYCELL) conversion.
55. QUERY	Identifies the characteristics of any point, line or polygon on the CRT by touching the location with the cross hairs.